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the establishment of long cycles of unfavorable climatic conditions in place of the recognized alternating favorable and unfavorable short-period fluctuations characteristic of arid regions. The geographic history of northern Arizona is the history of the Kisaní race. Many details of this history are recorded, but its large features and its dominant controls are as yet unknown. The problem is comparable to that presented by the Incas of Peru and is, I believe, to be solved by methods adopted for that work: a long period of field study of the geographic history of the region carried on in the presence of the ruins and assisted by the descendants of the old race. With suitable maps at hand, two years' field study among the unmolested ruins and uncharted terraces of Rainbow Plateau should result in a valuable contribution to the geography of the Navajo country.\*

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\* Reference should also be had to the note on the Navajo Indians under "Geographical Record" in this number.—ED.

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## CLIMATIC SUBDIVISIONS OF THE UNITED STATES

By ROBERT DeC. WARD  
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In dealing with the climatology of an area as large as that of the United States, we must, if our discussion is to be clear and systematic, adopt some scheme of subdivision into climatic districts, or provinces. Many suggestions have already been made along this line, and Mr. W. L. G. Joerg has recently done a useful piece of work in bringing together reproductions of the most important classifications of the "natural regions" or provinces of North America and of the United States.<sup>1</sup> Twenty-one different schemes are presented. Eight are grouped as *structural*, 4 as *climatic*, 2 as *vegetational*, 1 as *zoogeographic*, and 6 as *natural regions*. In addition, Mr. Joerg gives a new classification in which he has selected what seems to him best in the others.

Of the climatic classifications included by Mr. Joerg, those of

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<sup>1</sup> W. L. G. Joerg: "The Subdivision of North America into Natural Regions: A Preliminary Inquiry." *Annals Assoc. Amer. Geogr.*, Vol. IV, 1914, pp. 55-83. Also gives references to other classifications not especially considered in the article. It adds greatly to the convenience of the reader that one scale of map is used for all the North American classifications, and one scale for all those dealing with the United States.

Hult, de Martonne and Köppen seem to the writer too detailed for general use. Supan's map is the most widely known.<sup>2</sup>

The United States Signal Service and Weather Bureau have, at various times, adopted different subdivisions, none of them included in Mr. Joerg's article, but these are all groupings of districts and stations for convenience of administration, of forecasting, of the collection of data, or of reference, rather than climatic provinces. Hence state or purely arbitrary lines have generally been taken as the limits of the different divisions, although the larger topographic

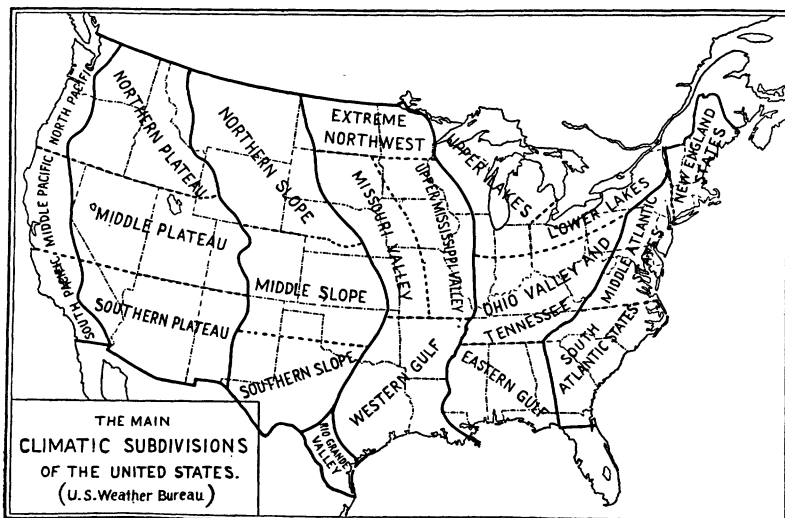


FIG. 1

features, such as the Rocky Mountains and the Sierra Nevada-Cascades, have also been used. A good many years ago the Signal Service adopted a scheme of 21 "climatic subdivisions," which has been retained with little change, but is now used only in the main table of climatic data that has appeared without appreciable change monthly in the *Weather Review* for the past 30 years or more under the heading, "Table 1: Climatological Data for the United States," etc.; and in the synopsis of weather conditions on the Washington daily weather map<sup>3</sup> (Fig. 1).

<sup>2</sup>The classifications of Hult, Köppen and Supan have been considered by R. DeC. Ward: "The Classification of Climates," *Bull. Amer. Geogr. Soc.*, Vol. 38, 1906, pp. 401-412 and 465-477. The maps of Supan and of Köppen are also reproduced in the writer's "Climate, Considered Especially in Relation to Man," 1908, Chap. III. Supan's map may also be found in the "Atlas of Meteorology," 1899, Pl. I.

<sup>3</sup>This map was published in Dunwoody's "Weather Proverbs," *U. S. Signal Service Notes*, No. IX, 1883. Also, in greatly reduced form, in Waldo's "Elementary Meteorology," 1896, p. 318.

A somewhat simpler set of subdivisions is that now used for the weekly forecasts, given to the press each Tuesday and published in the *National Weather and Crop Bulletin* (Fig. 2).

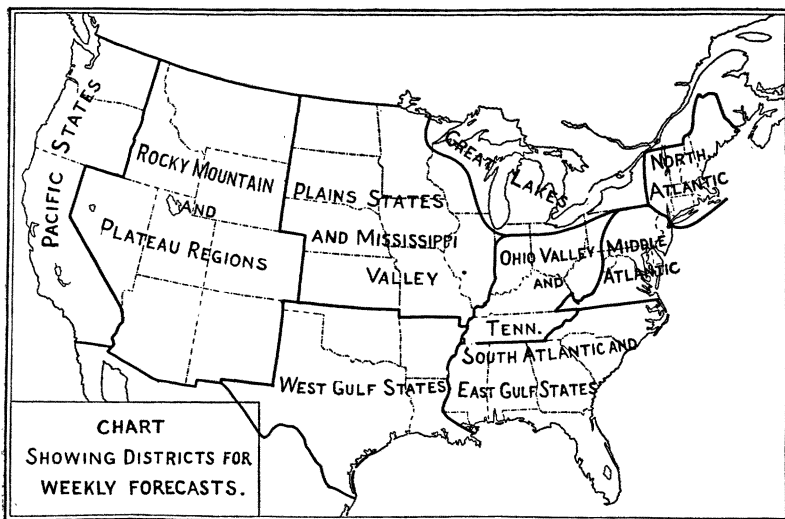


FIG. 2

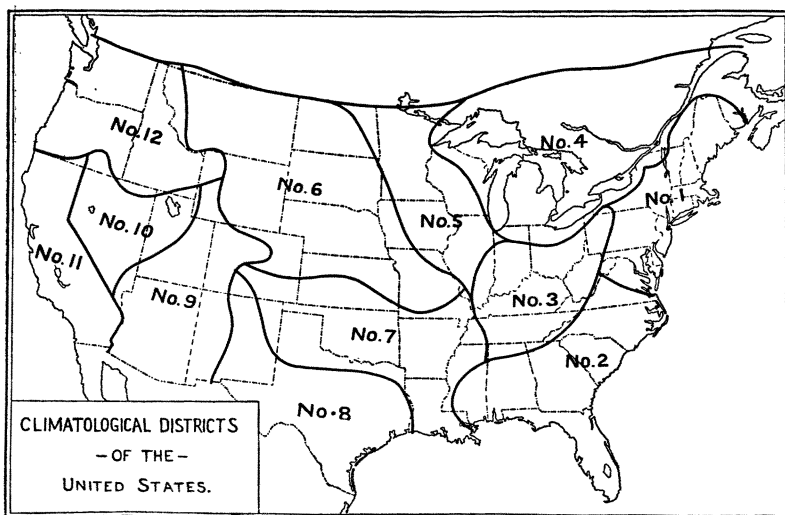


FIG. 3

Beginning with July, 1909, the Weather Bureau, cooperating with various other Government scientific departments, adopted 12 large districts, "generally having the same boundaries as the great

drainage basins of the country, these boundaries being marked off by the natural topographical divides" (Fig. 3).

These divisions were called "climatic districts." This they were to some extent, but the drainage area, not the climate, was the basis of subdivision. This scheme of classification was continued for the publication of the daily and monthly data from all stations in the *Monthly Weather Review* until the end of 1913.

For the general purposes of the publication of climatic data, the Weather Bureau has more recently adopted 106 "climatological sections," determined partly by state lines and partly by considerations of administrative convenience. Topography is taken into account in some cases (Fig. 4). This scheme was adopted in the "Summaries of Climatological Data by Sections," published as *Bulletin W*, 1912.

This great variety of suggested subdivisions, whether primarily physiographic, botanical, zoological, climatic, or "natural regions," is confusing, if not discouraging. Moreover, there is no limit to the number of possible classifications, for these depend on any author's special interest or view-point, which may be climatic, or botanical, or physiographic, or one of administrative convenience. Even from the single view-point of climate alone, an almost infinite number of classifications might be proposed, for we may take as the basis of subdivision either the special conditions of one climatic element, or various combinations of two or more elements.

In working out a scheme of climatic subdivisions there seem to the writer to be a few essential considerations which should be kept in view. The classification must be simple. The separate divisions should, when possible, be bounded by large and easily recognized physical, or political, lines. Arbitrary limits, difficult to remember and to locate, should be avoided whenever possible. The scheme ought not to be too individual, but should commend itself to those who wish to use it on the ground of its being rational and practical. In any climate in which the cyclonic and anticyclonic control of weather types is a distinguishing characteristic, as it is in the belt of the prevailing westerlies, the climatic subdivisions should be determined with due regard to this control, for it is weather which, in the long run, gives a climate its character.<sup>4</sup> In other words, the subdivisions should be chosen because of their special relations to cyclonic and anticyclonic tracks and movements; to local and characteristic weather distribution around lows and highs; to

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<sup>4</sup> This matter has been more fully discussed by the writer in a recent paper, "The Weather Element in American Climates," *Annals Assoc. Amer. Geogr.* Vol. IV, 1914, pp. 3-54.

cyclonic and anticyclonic winds; and because of the general similarity of weather types over each province. Finally, the districts should, as far as possible, be the same as those which have been officially adopted in the publication of the meteorological and climatic data of the region. If, for example, the published data are grouped according to one scheme, while the climatic subdivisions are based upon a different scheme, there is great inconvenience in the use of these data. To take the specific case of the United States. When there is no good and sufficient reason for using other boundaries, state lines and the divisions adopted in the Weather Bureau's 106 "Climatological Sections" (see p. 669) are both convenient and practical.<sup>5</sup> Such a classification of climatic provinces makes it an easy matter to look up the special and detailed characteristics of each subdivision in the official publications of the Weather Bureau. The importance of this point will readily be appreciated by those who have endeavored to work out the climatology of some "climatic province" which did not coincide with any unit area adopted for purposes of publication of the official data.

In the United States there are three great natural topographic and climatic subdivisions. These are (1) the eastern, embracing about one-half of the whole area, extending from east of the Rocky Mountains to the Atlantic Ocean and Gulf of Mexico; (2) the western mountain and plateau district, and (3) the narrow Pacific slope. Nowhere in the United States are sudden changes in climate to be met with in going from north to south, or *vice versa*. The transition is everywhere slow and gradual. The natural climatic subdivisions are, therefore, separated by meridional, not by latitudinal, lines. So far as east-west boundaries are necessary, these are therefore inevitably largely arbitrary.

*Eastern Province.* The first, great Eastern climatic district, enormous as is its extent, has nevertheless a certain remarkable uniformity in its weather types and its climate. It is freely open to east, north and south; to the Atlantic, to Canada, and to the Gulf of Mexico. Its seasons are strongly contrasted; its winter temperature gradients between north and south are unusually steep; its continental climate reaches to the Atlantic seacoast, with little modifying effect of the ocean waters; its rainfall is, as a whole, plentiful and well distributed throughout the year; its frequent and well-developed cyclones give it many, rapid and marked weather changes and sharply contrasted weather types, controlled to a large

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<sup>5</sup>In Professor A. J. Henry's "Climatology of the United States," *Bulletin Q*, 1906, the numerical data are all given by states.

extent by the diversity of temperature and of moisture conditions of the district from which the winds come. With the approach towards the Rocky Mountain area, on the west, there comes also a gradual transition to the drier, sunnier, and less cyclonically controlled climate of the Great Plains and eastern foothills. There is here no easily fixed and sharply determinable climatic boundary, although the lines of equal rainfall, cloudiness and relative humidity all trend very generally north and south. The 100th meridian, the critical mean annual isohyetal line of 20 inches, and the 2,000-

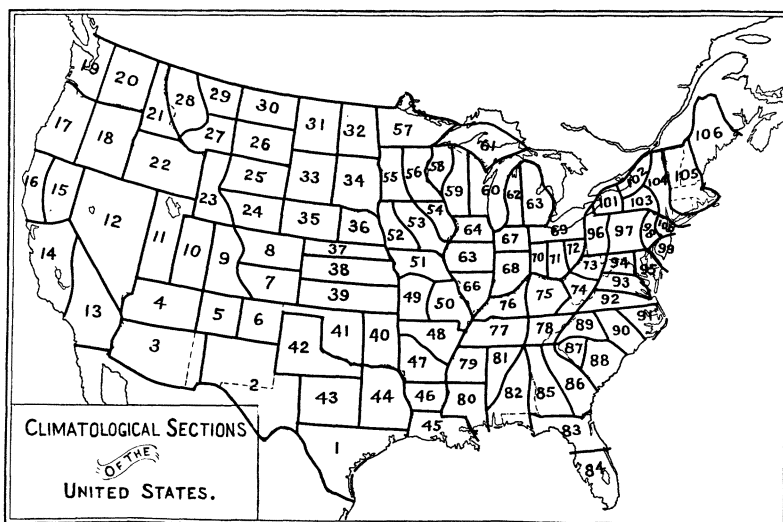


FIG. 4

foot contour line, are all reasonably satisfactory. For our purpose we have selected the (generalized) line which follows the 2,000-foot contour. This agrees fairly closely with the 20-inch isohyetal line, and also with the 100th meridian, and marks the eastern margin of the physiographic unit of the Great Plains (Fig. 5).

*Gulf Province.* To the south, over the states bordering on the Gulf of Mexico, the temperatures are higher; the winters are much milder; the cyclonic control is weaker; the temperature and weather changes are fewer and less emphatic; diurnal phenomena are more marked; conditions are more "settled"; the rainfall is heavier and usually has a marked summer maximum. Here, on these great warm, damp lowlands of the southern coastal plain, we have the wealth of southern cotton, and sugar cane, and subtropical fruits. For these, and other reasons, this southern portion of our great Eastern dis-

trict may well be set apart as a subordinate climatic province. There is, however, no sharp climatic boundary of any kind which may be taken as the limit of this southern Gulf province. Hence an arbitrary line has been drawn, which includes, on the south, most of the Gulf coastal plain; is not far from the position of the mean annual (surface) isotherm of  $65^{\circ}$ , marks, in its central portion, the northernmost position of the 100-foot-contour line, and also accords with the dividing lines between four of the Weather Bureau's official "climatological sections."

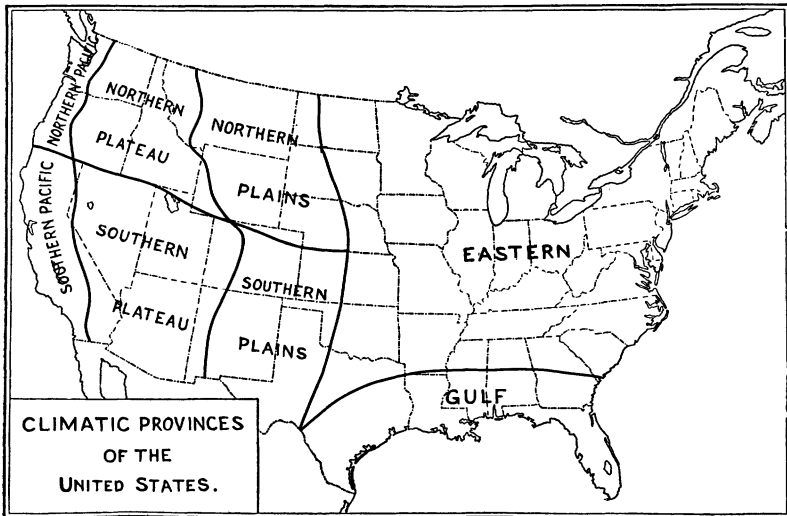


FIG. 5

*Plains Province.* The Plains climatic province in the proposed classification is included between the (generalized) line following the 2,000-foot contour and the (generalized) line of the main Rocky Mountain divide. The latter may be taken as a fairly satisfactory climatic boundary in relation to rainfall, cold waves, the direction and characteristics of the winds, and the prevailing weather types. The cyclonic control is less marked over the Plains than over the Eastern province, both because of the difference in relation to the storm tracks, and because of the generally less emphatic development of the storms themselves. The climatic differences due to latitude and relation to cyclonic control are so considerable between the northern and southern Plains that a dividing line, which, however, marks no climatic boundary, may be drawn following in a general way the state lines between Wyoming, Nebraska, Colorado and Kansas; and



thus conveniently agreeing with divisions adopted by the Weather Bureau.

*Plateau Province.* The Rocky Mountain divide on the east, and the Sierra Nevada-Cascade divide on the west (both broadly generalized) are natural and convenient boundaries for the Plateau province. A great interior region of mountain ranges, high plateaus and deserts, its chief characteristic is its small rainfall. It has the minimum cloudiness and the minimum relative humidity in the United States. Comparatively few cyclonic storms cross it. A persistence of winter high- and of summer low-pressure conditions characterizes it. The rain-shadow effect of its western mountain barrier necessitates irrigation undertakings, and where these are impracticable the aridity of the desert reigns supreme. Severe cold waves of the eastern type are barred out by the Rocky Mountain barrier. Diurnal, rather than cyclonic, phenomena prevail. Mountain climates, with their special peculiarities of strong sunshine, dry air and large temperature ranges, are here found. An east-west line, roughly coinciding with the state boundaries of Oregon and Idaho on the north, and of Nevada, Utah and Colorado on the south, agrees, in a general way, with the southern boundary of the Columbia plateau, and also with boundaries of the Weather Bureau climatological sections. Hence, such a line may serve as a convenient division between the northern and southern Plateau provinces.

*Pacific Province.* The narrow coastal strip west of the Sierra Nevada-Cascades is the Pacific province, with its great variety of climates, from rainy to arid, from those of the lowlands to those of the snow-covered mountain tops, from the cool summers of the coast to the great heat of the interior; with its prevailing mildness and equability, its subtropical rainy season and subtropical cyclonic controls, its great forests and its fertile agricultural valleys, its irrigated fruit orchards and its far-famed California health resorts. Between the rainier, cloudier, damper and more changeable north, and the drier and more settled south, the state line between California and Oregon is an easily determined and fairly satisfactory boundary. It does not differ greatly from the topographic divide between these states, and accords with the established scheme of subdivision adopted in the publication of the Weather Bureau climatic data.

For purposes of teaching the writer has found the scheme of climatic subdivisions here presented simple, useful and satisfactory.

The eight separate provinces are large enough to make further subdivision possible, to meet any special preferences or needs. The boundary lines are easily determined and easily remembered. And the provinces here adopted are such that the official Weather Bureau data, which are mostly subdivided on a state basis, may easily be fitted into the scheme.

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## ARGENTINA AND THE ARGENTINES\*

By BAILEY WILLIS

Leland Stanford Junior University

Contrasts strongly distinguish North and South America, and among those most generally recognized in the popular mind there is none more conspicuous than the stability of self-government in the one and its instability in the other continent. The causes are racial in part; they are in a measure inheritances from distinct colonial policies; and they are also due to geographic conditions. The last are unfortunately permanent. Self-government is a hardy plant. Like wheat and oats it flourishes where there is ozone in the air and frost. Argentina is the wheat country of South America. And it is the home of that Latin American people which, in developing a truly republican government, leads among Spanish Americans.

The great valley of Chile and parts of southern Brazil, like Argentina, enjoy a temperate climate. In those selvas, pampas, and Andean valleys of the tapering tip of South America, only one-fifth of the continent in area, men may develop the combination of physical and intellectual qualities which make organizers and rulers of great states. They have energy and brilliancy as individuals, they are learning coöperation, patience, and true patriotism as nations, and there is hope that they may be able to establish popular government on a firm basis within their own dominion, and administer for humanity the vast riches of tropical South America, where that hope has proved illusory.

The highland of southern Brazil and Uruguay, stretching from Rio de Janeiro to Montevideo and from the coast to the Paraná, is an area as large as that which lies in the United States between the Great Lakes and the Gulf and the heights of the Alleghanies and the Mississippi. Outside of the great centers Rio de Janeiro and

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\* Abstract of a paper read at the joint meeting of the Association of American Geographers and the American Geographical Society in New York on April 10, 1915.